Examining the linkages between AIDS and biodiversity conservation in coastal Tanzania

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Abstract

This paper summarizes a field study on the linkages between AIDS and coastal biodiversity in eight coastal villages in the Bagamoyo and Pangani Districts in Tanzania. Summarizing the current literature, we suggest that there are three categories of direct impacts of AIDS on natural resources—accelerated rate of resources extraction, decreased availability of labor and management capacity, and loss of indigenous knowledge on coastal resource management and biodiversity conservation. Evidence of these types of detrimental impacts of AIDS on the natural environment is found in the coastal villages of Tanzania, but overall it is difficult to disentangle the impacts of AIDS on local resource use and biodiversity conservation from other factors driving change. However, this paper contributes to an understanding of the key factors critical in shaping the impact of AIDS on the natural environment in coastal areas—especially gender inequity and migration. Our conclusion is that reducing gender inequality and poverty, and improving livelihood opportunities are integral to mitigating the negative impacts of AIDS on natural resources.

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1. Introduction

More than 1.8 million adults (7%) in Tanzania currently live with HIV/AIDS—and AIDS-related illnesses are now the primary cause of illness and death among adults in Tanzania [1]. The HIV-prevalence rate varies significantly between age groups—it is highest among women between ages 30 and 34 (13%) and among men between 40 and 44 (12%) [1]. The rate of HIV infection also varies between geographical regions—from 2% in the Manyara and Kigoma regions to 13.5% in the Iringa and Mbeya regions. In sub-Saharan Africa, AIDS is not only a health issue, but also a development problem, manifesting itself through escalating under-development and poverty, intensified socio-economic imbalances, and deepened impacts of natural and human-made disasters [2]. Poverty and inequality between women and men are both strongly connected to the spread of HIV, where poverty often drives women to unsafe sexual encounters. Women are doubly hit, because not only are more females than males infected every day—they are also the primary care givers when a household member becomes ill [3].

The impacts on resources conditions and management are less clear, but AIDS is thought to cause overuse of natural resources, loss of traditional knowledge, loss of human capacity and labor, increased vulnerability of community-based natural resources management (CBNRM), and diversion of conservation funds to meet HIV/AIDS-related costs [4–8]. Community development and natural resources managers are increasingly becoming aware of the pandemic and its impacts, but till date, few have mainstreamed HIV/AIDS-related issues into their work [2,9].

In East Africa, the Lake Victoria Region was the first area to be severely hit by HIV/AIDS, but with time the epidemic has spread to other regions as well. This observation is supported by the fact that the Lake Zone regions in Tanzania no longer have the highest HIV prevalence rates. Research suggests that fishers are a high-risk group together with truck drivers, miners and other professionals who spend periods of time away from home [9–15]. This paper builds on previous research to understand how AIDS impacts biodiversity in coastal Tanzania and how gender inequities, poverty, and the mobility of artisanal marine fishers exacerbate the situation. We first introduce the methods used and the study site—documenting the immense challenges to peoples’ livelihood in the eight villages in the Pangani and Bagamoyo Districts. We then discuss the potential impacts of AIDS on coastal biodiversity and provide evidence of these types of impacts in rural Tanzania. Finally, we analyze how gender relations and migration are critical factors shaping people’s behavior and making the communities susceptible and vulnerable to the impacts of AIDS—especially as it relates to coastal biodiversity conservation and resource management.

1.1. The study area

This paper is based on a study conducted in coastal Tanzania encompassing an area with several terrestrial and marine conservation zones and adjacent communities located in the southern portion of the Pangani district and the northern area of Bagamoyo district. There are eight coastal villages in the area—Matipwili, Saadani, Mkalamo, Mkwaja, Mikocheni, Buyuni, Ushongo, and Sange (Fig. 1). The villages were specifically selected for their importance to biodiversity conservation. All the villages border on or are surrounded by
the Saadani National Park, except Ushongo, which is located about 15 km from the park boundary. The Saadani National Park has recently been upgraded from game reserve to National Park status. This provides a higher level of protection for biodiversity conservation within the park and creates a need to rethink conservation strategies and interactions with neighboring communities. In addition, six of the project villages are part of community-based fisheries management areas. The Boza-Sange Collaborative Management area includes two closed reefs (Maziwe reef of Maziwe National Marine Reserve and Dambwe reef) and encompasses the Madete beach area of the Saadani National Park. The area thus includes a mix of both land and sea environments and several types of protected areas.
1.2. Methods

The linkages and threats associated with HIV/AIDS, coastal biodiversity, gender, and migration were evaluated using several methods over a 6-month period—January to June 2005. Information was collected from secondary sources (e.g. national and district statistics) on demographics and biodiversity in the study area, including GIS data on land cover and land use change for 1990 and 2000. This data came from Landsat TM images acquired between 1986 and 1993—and Landsat-7 ETM+ images acquired between 2000 and 2001 [16]. A Participatory Rural Appraisal (PRA) was conducted in each of the eight project villages over a 2-week period. An interdisciplinary appraisal team spent 1 day in each of the five villages (Matipwili, Mkalamo, Mkwaja, Saadani, and Ushongo) and conducted a set of PRA exercises:

- Focus group discussions with village Environment Committees, HIV/AIDS Committees, groups of women, and groups of fishers (or other resource users).
- Village sketch map exercise.
- Transect walk exercise and direct observations during fieldwork.
- Trend line exercise.
- Gender disaggregated activity map.
- Resource control and access map.
- Key informant interviews using semi-structured checklists involving health workers, traditional healers, religious leaders and influential elders.

In the three other villages (Buyuni, Sange, and Mikocheni), a smaller appraisal team conducted a less comprehensive set of exercises and meetings. A total of 136 men and 85 women participated in meetings and exercises with the appraisal team. A stakeholder workshop was held to review and provide feedback on the PRA information. We also conducted key informant interviews with the Tanga Coastal Zone Conservation and Development Program and Saadani National Park employees and with hotel owners.

Two sets of intensive follow-up interviews were conducted with village residents after the PRA activities were completed: seven interviews were conducted with a non-random sample of individuals belonging to AIDS-affected households. Due to the sensitivity of identifying and interviewing people who are sick with AIDS-related illnesses, these individuals were identified and interviewed in confidentiality by the District HIV/AIDS officer, who already knew them and their medical history. The district officer administered a questionnaire survey instrument that included both closed and short-answer open-ended questions.

Twenty scenario interviews were conducted with a random sample of individuals from one inland (farming dominated households) and one coastal village (fishing dominated households). One person was interviewed per household—the male or female head of household or the spouse. The purpose of these interviews was to better understand community members’ perceptions of how household behavior might change if a family member became sick or died as a result of AIDS. These interviews were added since the number of AIDS-affected households that could be interviewed directly was relatively small with no certainty that the AIDS-affected households were involved in any way with natural resource-based livelihood activities. A short scenario statement was read to the interviewee, asking them if a family member of an imaginary neighbor became sick or died...
from AIDS, how the interviewee thought that family would respond. The open ended verbal responses were summarized and written down by the interviewer.

1.3. Biodiversity and conservation

The area encompasses a number of protected areas that aim to conserve marine and terrestrial biodiversity in the area (Fig. 1). The largest is the Saadani National Park, which includes both terrestrial and marine habitats. There are also a number of small marine conservation areas including the Maziwe Island Marine Reserve, and no-take zones as part of collaborative fisheries management areas.

**Saadani National Park (SANAPA)** is located along the coast, about 80-km north of Dar es Salaam. Tanzania’s legislative body approved the law establishing the Park in October 2004 and it was gazetted in November 2005. The combined area of the Park is 1137 km² of which 66 km² is marine area [17]. The Park cuts across the Tanga and Coast regions and is situated in Pangani and Bagamoyo Districts, with a small portion in Handeni District. There are 10 villages bordering the Park with a total population of approximately 35,000 [18]. Saadani National Park is unique because it is the only coastal wildlife reserve in Tanzania, having a wide variety of habitats including closed forest reserve, wetlands, palm and acacia woodlands, open grasslands, coastal thickets, river and estuarine systems, mangrove swamps, and marine areas. These habitats accommodate a wide variety and high number of endemic plants, animals, birds and invertebrates.

A land use and land cover analysis showed that the amount of bare soil inside Saadani National Park increased by over 192 km² between 1990 and 2000, while the area of grassland decreased by a similar amount. This trend is also seen in the area outside the park but to a lesser degree. PRA participants reported lack of rain as a serious issue occurring over the past 5 years and drought coupled with overgrazing by wildlife may explain the large increase of bare soil inside the Park. However, since the multiple Landsat images used in this analysis were taken at varying times of the year, the observed differences may also be an effect of seasonal fluctuations. The data also showed that the amount of agricultural land (all land types with crops and cultivated lands) outside the park has increased by 76% (20,000 ha). This is attributed primarily to increases in bushland and woodland areas containing crops. At the same time, there has been a large decrease in the area of open and closed woodlands (14,800 and 3800 ha, respectively) outside the park.

Villagers perceive that the park has made their life more difficult. In interviews, several of the villages noted problems in obtaining poles and fuel wood since Mkwaja Ranch was appropriated by SANAPA. Other villages noted that the SANAPA boundaries increase the distances that villagers have to travel when visiting neighboring villages. For example, the closure of Madete beach significantly increases the walk between Buyuni and Mkwaja villages as the villagers have to walk along the road instead of going straight along the beach. If enforced, the beach closure and the closed marine area would also limit the access for fishermen to launch their boats and fish in the surrounding waters. However, closed areas are also proven to have a positive impact on fish habitats [19,20].

**Maziwe Island**, established in 1975 as a marine reserve, submerged in the late 1970s and now remains as a sand bank and coral reef located to the East of Pangani District. The main purpose of establishing the reserve was to improve the ecosystem, conserve species, increase fish production, and boost the local income of communities in adjacent mainland
coastal villages. The reefs within the Maziwe reserve have abundant biological resources, with the highest number of coral genera in good condition in the Tanga Region [21]. Earlier, the reef surrounding the Maziwe Island was infested with sea urchins, an indicator of poor reef health. The situation improved following the introduction of management measures that included the creation of zones for closed and open reefs and strict local fishing regulations. Reef health has been monitored since 1998 by the Tanga Coastal Zone Conservation and Development Program (TCZCDP), which has recorded a significant decline in urchin density on open and closed reefs during the past 7 years. Live coral cover has also improved over the years, increasing from 45% in 1999 to approximately 75% on the closed reef. Some improvements have also been recorded on the open reefs [18].

Collaborative Management Areas (CMAs) were established under the TCZCDP. These are near-shore marine areas managed primarily for fisheries purposes and include no-take zones that also provide conservation benefits. The TCZCDP covers the three coastal districts of Muheza, Pangani and Tanga Municipality of the Tanga Region. The program started in 1994 and has adapted its approach to fisheries and marine management over time based on field experience. CMAs involve development of plans covering a wide range of issues with multiple villages using common marine resources. The main objective of the program has been to improve livelihoods through better and sustainable management of marine resources. The fundamental approach is to involve resource users in the participatory development, review, negotiation and implementation of plan [22]. Six CMAs, varying in size from 100 to 559 km², have been established with small no-take zones ranging from 2 to 10 km² [18]. The two southernmost CMAs—the Boza-Sange and Sange–Mkwaja–Buyuni, located in the Pangani District adjacent to the Saadani National Park, were covered in this study. While the TCZCDP has made significant inroads in decreasing destructive fishing practices over the last decade, recent concerns have been raised about a resurgence of dynamite fishing in these areas and around Maziwe marine reserve.

Marine environmental data suggest that the no-take zones in the CMAs are having a positive benefit on some aspects of marine biodiversity, especially on benthic habitat and reef health and particularly in the Boza-Sange and Mkwaja–Buyuni CMAs [21,23]. It should be pointed out however, that data collected by the TCZCDP are indirect indicators of biodiversity (e.g. percent live coral cover and abundance of selected indicator species) and do not measure directly any specific information on species diversity. Secondary data on the Boza-Sange CMA showed that the average number of commercial reef fish has varied over time, but at all monitoring events, abundance has been greater on the closed reefs [18]. However, there are no noticeable trends of increasing abundance outside the reserves since they were established. Fishers interviewed during the PRA also indicated continuing declines in catch. While scientific evidence reported by Halpern [19] suggests that size does not matter, the small size of the no-take zones relative to the overall size of the CMAs coupled with fishing effort may make these no-take areas too small to see a noticeable spillover impact on exploited species of fish, even though selected benthic species and habitat seem to demonstrate a “reserve effect.” The reserve effect and evidence of spillover has been documented for tropical marine reserves [24].

1.4. Socio-economic context and livelihoods

There is little physical infrastructure and social services in the eight villages. All roads are unsurfaced and many become impassable during the rainy season. There is no piped
water and five of the eight villages have no electricity. Walking or bicycles are the primary means of movement. Health and education services are also minimal. For example, no village has a secondary school. Matipwili, Saadani, and Mkwaja have health centers, or “dispensaries.” The villages of Ushongo and Sange have first aid stations, but they do not have regular qualified staff or a reliable supply of medicines. Matipwili village health center provides voluntary counseling and testing (VCT) services for pregnant women. It is the only village in the project area to offer any VCT services. Other health facilities in the project area that can provide case diagnosis are limited to Pangani and Bagamoyo district hospitals and at an NGO-run facility (Tanga AIDS Working Group-TAWG) in Pangani town. These facilities are located 15–60 km from the villages.

There is great potential for tourism within the study site, with the SANAPA, the Maziwe reserve, and the sandy beaches of Pangani. There are a few hotels adjacent to SANAPA and in Pangani, but it is still relatively undeveloped. For example, in 2004, only 448 tourists visited the Maziwe reserve. Even this low-level tourism has impacts on the villages as the hotels provide employment for a few persons. The lodges are also known to buy fish and other supplies from the villages. Just to the north of the village Ushongo Mtoni are three small beach resorts (Ushongo Beach Resort, Emayani and Tides) each with a capacity of about 20 guests. The village receives 5% of annual hotel income for village development.

Households in the villages are heavily dependent on a primary livelihood of either fishing or farming. Artisanal fishing is by far the most important economic activity in the five coastal villages (Saadani, Mkwaja, Ushongo, Buyuni, and Sange) involving about 70–80% of the male population. Fishing households harvest a great diversity of species: fish (especially, rabbitfish, emperor fish, rays, and groupers), octopus, sea cucumbers, spiny lobsters, shells, corals and prawns/shrimp. The fishery is largely coral reef based, occurring within 15 km of shore. Men do most of the fishing and, as will be described in more detail below, many move in a pattern of seasonal migration, depending on the fishing season. Women fish in shallow water for shrimp, process and market fish, and collect octopus and mollusks at low tide [25–27].

The income earned from fishing across the villages in the study area is very low. In all cases, fishers and their families are unable to save money and live in a continual state of financial insecurity. Declining fish abundance and catch, poor quality boats (making fishing in deeper waters impossible), and a lack of engines and equipment are identified by fishers as the primary causes of continuing low return.

In the coastal villages, fertile land is scarce and there is little farming of food crops aside from coconuts and cashew nuts. Most of the potential arable land is located within SANAPA—in the area where the Mkwaja Ranch used to be—and therefore cannot be cultivated. There are also severe problems of crop losses from foraging wild animals, especially in villages that border SANAPA (Saadani, Buyuni, Mkwaja, and Sange). The frequent invasion of elephants, baboons, and warthogs into the farms has stimulated regular complaints from the villagers about the “SANAPA animals.” Drought and chronic food shortages are also significant problems in these coastal villages and most of the villagers now depend on imported agricultural goods from neighboring inland villages and urban areas.

In the three villages that are not located directly on the coast (Matipwili, Mkalamo, and Mikocheni), farming is the primary livelihood. Matipwili village is located along the fertile shore of the Wami River, the only river in the region that flows throughout the year. Corn
and peas are grown in the period of low rains and rice is cultivated during the rainy season when the fields are flooded. Other crops include plantains, pineapples and cassava. Mkalamo and Mikocheni are experiencing periods of extremely low production in agriculture and significant food shortages. Food insecurity is due mainly to recurrent drought, damage from wild animals, and a lack of interest among younger generations to undertake agricultural activities.

The boundaries of SANAPA generally exclude settlement areas, and as a result, seven of the eight project villages are either completely surrounded by the Park or situated very close to the park borders. These villages are exposed to marauding wild animals such as baboons, velvet monkeys, warthogs, elephants, and lions. Wild animals make it more difficult to collect water and fuel wood from sources outside the village and destroy crops and trees. In villages that are already poorly nourished, the loss of available land due to SANAPA and the loss of crops or inability to farm because of animals add another dimension of vulnerability. Insecurity as a result of loss of crops from wild animals results in reduced production and unwillingness to invest further in agriculture. Furthermore, drought conditions over the past 4 years and a general deviation in the normal rainfall patterns have caused at least three villages—Saadani, Mkalamo, and Mkwaja—to experience severe food shortages for several years.

Poverty, food shortages, and meager livelihood opportunities make these villages particularly susceptible to AIDS-related illnesses \[2,28\]. Failure to maintain sufficient nutrition weakens immunity and increases susceptibilities to opportunistic infections—which hastens the onset of full-blown AIDS \[8\]. Reducing available household labor, AIDS both causes and exacerbates vulnerability to episodes of acute food insecurity, as well as chronic food insecurity \[8\]. Shocks that used to be weathered may become more significant in the context of AIDS. Furthermore, during times of food insecurity, such as drought, individuals can be forced to engage in survival strategies that increase their vulnerability to contracting HIV \[6\]. For example, poverty drives some women and young girls to accept unsafe sex and expose themselves to sexually transmitted infections, including HIV \[3\]. Evidence from the Saadani village indicates an increased prevalence of expanded sexual activities during the prawn-fishing season. For the majority of women who migrate to Saadani during the peak fishing season, engaging in sexual activities in exchange for money is a “poverty alleviation” strategy.

The following section will explain how AIDS may fuel poverty and food insecurity by reducing the availability of productive labor capacity and traditional knowledge, and contribute to degradation of natural resources.

2. Impacts of AIDS on biodiversity

Little has been published in the academic literature till date regarding the nexus between AIDS and biodiversity conservation \[11\]. But, summarizing the existing, often “gray” literature \[2,4–6,15\] we have drawn the conclusion that AIDS has three direct impacts on coastal resources and biodiversity. These direct impacts are: (1) accelerated rate of extraction of natural resources due to increased dependence on wild foods and wildlife, medicinal plants, timber, and fuel wood; (2) decreased availability of labor and management capacity due to sickness and death; and (3) loss of traditional/indigenous knowledge and skills.
AIDS can lead to an accelerated rate of resource extraction when people turn to natural resources as a means to replace household income that is lost after an income-earning family member dies from an AIDS-related illness or is too sick to work. The result is often increased resource dependence and intensity of use [4]. Furthermore, people who have been affected by or afflicted with HIV/AIDS may develop a short-term outlook on both economic and environmental issues [8]. For example, business enterprises such as tourism that require long-term economic or labor investments may not be as attractive or viable to an entrepreneur who is ill or taking care of a sick family member or who has many ill workers. Also, AIDS-affected communities or households may exhibit less respect for conservation rules and sustainable practices in agriculture, fishing and other resource dependent activities such as harvesting of wood or medicinal plants, because they do not see the long-term benefits of stewardship accruing to them personally.

Field evidence from the PRA and follow-up interviews indicates an accelerated rate of resource extraction due to AIDS and increasing poverty in the area. For example, the use of small-mesh nets for both marine and freshwater fishing is common among households in the villages as they try to make a living from declining fish stocks. In the scenario interviews, villagers maintained that households that are affected by HIV/AIDS are forced to diversify their activities in order to earn more income. Increased activity often puts increased stress on the resource base. One fisherman recounted that, “When my family member became ill, I continued fishing, but I also had to diversify to get additional income—I chose to hire people to make charcoal, which I sell in Zanzibar.”

Out of the seven AIDS-affected households that were interviewed in this study, five claimed that their farming activities have been negatively impacted—either because one or more family members was too sick to work, or because they have to divert time to care for a family member who was sick. One 40-year-old widow said that, “Before my husband died [as a result of AIDS], I was a housewife and my husband worked in the Sea Salt Company. When he became sick, we used his salary and our savings to pay for medical care. When he died, I invested the remaining funds in a fish frying business. I know other women who have opted to be fishers, firewood collectors, and sellers of charcoal and firewood.” In another village, a man explained that sometimes it is not possible for him to go out fishing because he has to stay home and care for a sick family member. Indeed, when sick individuals are no longer able to farm or fish, they must find quicker, easier ways to bring in cash income. This often means a greater dependency on natural resources—in the making of charcoal, in the collection of wild foods or medicinal plants, or fishing in shallower waters.

The second direct, negative impact that AIDS can have on natural resources stems from an increase in mortality and the consequent reduction in labor capacity. Because HIV/AIDS primarily affects adults between the ages of 25 and 45 years—the very people who work to support families and are usually the most productive economically—loss of adult labor and the capacity for heavy labor often leads to changes in affected households’ use of land and water resources and agricultural practices [7]. A study conducted in Zambia found evidence that AIDS disrupted agricultural production, because people could not dedicate as much time to field labor as compared to household members who were healthy [29]. Many rural families combine fisheries and farming and loss of adults in their prime of life leads to serious labor shortages for both activities—and for childcare and household maintenance [11]. In Kenya, it is estimated that the agricultural sector will lose a total of 329,000 person-years by 2020 due to AIDS [11]. Fishing is also a labor-intensive and physically demanding sector, vulnerable to changes in fishers’ capacity for long work
hours. Sick fishermen may prefer fishing in shallow waters, resulting in greater environmental deterioration and depletion of fish stocks since near-shore waters are important marine habitats to sea grass, corals, and mangroves and serve as nurseries for juvenile fish [30].

HIV/AIDS has contributed to a reduction in labor capacity in the study area. In a scenario interview in Mkwaja village, we were told “if a man is sick or has a sick family member, he will not be able to go camp fishing [staying away for stretches of time]. He will lose time at sea and he will not be able to perform his normal work duties. At the same time he will have to provide financial and material support to the sick—this is a very stressful situation.” In the six villages where the primary economic activity is fishing, any loss of local labor is currently quickly and easily filled by high influxes of seasonal migrants during the prime fish harvesting months (March–June) and busy salt-making season (July–August). Therefore, although death and illness of fishers from AIDS-related diseases could reduce effort, the open access nature of the fisheries—and the readily available labor pool—means that this will likely not occur. But for individual local families, the loss of income from a male head-of-household puts additional burdens on his wife and children to find alternative sources of income.

AIDS can also lead to loss of trained and experienced people within the conservation community [4]. Because of changing priorities, it may also lead to a reduced rate of human capital accumulation in that fewer children are sent to school [31]. In the long run, this may mean that fewer people become educated as conservation practitioners. Conservation workers are often located in remote areas and may be away from their families for long stretches of time. This makes them especially vulnerable to HIV-infection since it increases their likelihood of taking new, possibly multiple, sexual partners. There is also a risk that they will bring HIV into remote communities with hitherto low prevalence rates. Interviews with government organizations in the area found that 13 persons (seven women and six men) engaged in environmental management activities have died from AIDS-related illnesses during the last 5 years. Additionally, three persons working for the TCZCDP have died in the past few years.

When staff members pass away, organizations lose institutional experience and memory. Loss of park rangers, extension officers, senior officials, and other conservation personnel, can have detrimental impacts on coastal biodiversity conservation. For example, when organizations lose personnel, they may have to divert some of their conservation funds to pay for death benefits and costs associated with caring for sick employees and funerals, while also suffering from increased employee absenteeism [4].

It is important that organizations establish procedures for preventing HIV/AIDS (e.g. through making condoms readily available to the employees) and coping with AIDS and the potential loss of personnel. One of the hotels we interviewed mentioned that they require their personnel to take HIV tests every month. This could be good or bad depending on how the tests are preformed (e.g. are they anonymous or not?) and how the results are dealt with (e.g. are infected personnel fired or do they get treatment and support?). The Wildlife and Environmental Society of Malawi has been a leader in the region, mainstreaming HIV/AIDS into the organization in 2003. Tanzania National Parks (TANAPA) have recently adopted a similar work-place policy on HIV/AIDS with a five-year implementation plan that includes elements of awareness raising, HIV transmission prevention, HIV/AIDS testing, care and treatment, work-place safety, and social support services. This policy has not yet been implemented in the Saadani National Park.
If a protected area loses some of its rangers to AIDS and are not replaced, villagers may become more inclined to poach or break other resource use rules, because the risk of getting caught is lower. This situation might be exacerbated if, knowing that they will die within a few years, villagers lose a long-term view of stewardship [11]. People may then become less willing to engage in community-based management, such as the Tanga Region’s collaborative fisheries management plans. The scenario interviews suggest that people who have been affected by HIV/AIDS are more likely to think about short-term solutions instead of longer-term management. Interviewees suggest that people will often opt for harvesting fuel wood and making charcoal—because it provides quick cash—and that community members may become more likely to engage in illegal activities, such as dynamite fishing and wildlife poaching, stressing already depleted stocks. However, dependence on natural resources for survival is very common among the coastal communities even without AIDS. Observations from the Wami-Mbiki area in the Bagamoyo, Morogoro, and Mvomero Districts demonstrated that the majority of the families studied relied on selling charcoal to keep them out of absolute poverty and obtain at least one meal per day [32].

Loss of traditional knowledge is the third direct impact that AIDS has on conservation and effective environmental management. When children have not acquired the skills to perform key agricultural, fishing, or other economic activities, livelihood insecurity increases [8]. Significantly, loss of knowledge about sustainable land and resource management practices, which are traditionally passed on between generations, can cause natural resources degradation and a decline in productivity. For example, as men in their prime-working years succumb to AIDS, more unskilled youth take on fishing responsibilities before they would otherwise do so. Youth generally have less respect for, or knowledge about, the unwritten laws that have enabled fishers to secure their livelihoods for generations without notable harm to the environment and coastal biodiversity [30].

Evidence of the loss of traditional knowledge and skills is difficult to discern with any certainty in these eight villages. The PRA exercise, however, showed that in many of the villages there has been a steady increase in female-headed households over the past 5–10 years resulting from divorce, separation, and widowhood. Women reported that women now head most households in Mkalamo. This may be partly attributed to AIDS as well as a general dissolving of social bonds in rural areas as a result of stress and changes in agrarian livelihood opportunities [33]. In Tanzania overall, the number of orphans have increased dramatically as a result of AIDS [34]. This suggests that knowledge and skills traditionally passed from a father or mother to his or her children may indeed be lost. Life expectancy estimates provided by the National Bureau of Statistics shows a reversal in the trend or stagnation of life expectancy at birth in the 2002 census as compared to the previous census. This change could be explained by the effect of the AIDS epidemic [35].

3. Critical factors

In coastal Tanzania, gender inequities and migration—especially the mobility among fishermen—are two factors that exacerbate the spread of HIV infections. The following sections will explain why we found these factors to be critical in shaping the impact of AIDS on the natural environment in coastal areas.
3.1. Gender roles and inequity

Understanding the different perceptions, roles, and responsibilities of men and women—and the culturally constructed power relations between them—is crucial for effectively addressing the root causes of risky sexual behavior. The AIDS epidemic is now embedded in the lives of these coastal men and women, and impacts not only the communities’ health and economic well-being, but it also threatens the surrounding natural environment.

Women in this coastal area of Tanzania have primary responsibility for rearing children and ensuring sufficient resources to meet family needs. Women also are the main managers of essential household resources like water, fuel for cooking, and food for household consumption [27,36–38]. Despite these significant responsibilities, the PRA found that the male head of household makes most decisions concerning income expenditure, labor allocation, health care provision, food production and acquisition (both agriculture and fishing), and mobility of family members. Access and control exercises, which were carried out in four of the eight coastal villages, revealed deeply embedded inequalities in access to income, transportation, and educational opportunities. In all villages, women suffer from a lack of decision-making power and very low status relative to men.

Women and teenage girls are believed to be especially vulnerable to HIV infection for biological, social, and cultural reasons [39,40]. The proportion of adults living with HIV/AIDS who are women is approximately 58% in Tanzania. In the Pwani region, women are three times more likely than men to be infected, and in the Tanga region, they are two times more likely to be HIV positive [1]. Girls living in coastal Tanzania marry at a very young age, often just after their first menstrual bleeding (12 or 13-year-old). Intergenerational sexual relationships and limited access to information make young girls particularly vulnerable to HIV infection [3]. Cultural and religious norms allow men to take several wives and young girls are often married to elderly wealthy men. The villagers maintained that the dowry is the driving motivation for parents to marry off their young daughters, and once a girl is married, it is very unlikely that she will continue her education. Divorce and remarriages are very common and partner sharing is observed to be on the increase, especially in villages with notable seasonal migrants, like Saadani. The cultural practice of polygyny also puts women in a vulnerable position—in Tanzania, women who are in polygynous unions have a HIV-infection rate of 9.9%, versus 6.6% for women in non-polygynous unions [1]. Furthermore, women are more likely to be asymptomatic of STI infection and less likely to seek treatment for STIs, resulting in chronic infections with more long-term complications. Untreated STIs increases the likelihood of HIV infection.

Villagers, especially women, have begun to experience the negative effects of caring for sick family members, increasing the work burden as well as the household expenditures. The scenario interviews indicated that women almost always are the primary caregivers when someone in a household becomes ill. If a man becomes sick, his wife takes care of him—if a woman becomes sick, a daughter will have to take care of her (or another female relative or neighbor if there are no daughters). In some households, if a woman becomes terminally ill, the husband sends the wife (and their children) back to her parents. The scenario interviews also revealed that the husband usually feels some obligation to support the family financially, but when the situation worsens, he often forsakes the woman and marries a new wife.

When women have to spend more time caring for sick people, they will have decreasing amounts of time to earn cash income outside the home, often leading to a cycle of poverty
and sickness. In the past, women earned cash income mainly from seaweed cultivation and coconut and cashew farming. But seaweed farming, once a lucrative business in Mkwaja and Ushongo, which women had enthusiastically embraced, is in decline. Coconut and cashew farming, other popular income-generating activities in several of the villages, are also no longer viable businesses, as the combination of disease and neglect, loss of ownership and access, and foraging by wild animals have largely decimated these crops. Women reported that while they use their small cash incomes on family expenses—food, medicines, school fees, etc. men spend their cash on “their individual wants.” In an effort to retain some control over at least a portion of household income, women have become more entrepreneurial and have adopted a variety of new coping strategies: collecting “extra” fuel wood or water that can be sold, engaging in alternative, non-traditional income-generating activities such as prawn fishing, alcohol brewing, weaving and selling mats and baskets, acting as “wholesalers” in the charcoal trade, and exchanging sex for money.

Women in the village of Sange reported that women “sleep with anyone if he has money, because life is hard, sometimes we don’t have time to work, and our husbands drink their money away.” Speaking frankly, the women continued, “We are afraid to know our HIV status, because knowledge will hasten death, and our husbands will divorce us before we die.” A woman in the village of Mkwaja explained further: women accept the fact that it is the “female burden” to provide for her children, so when a woman prostitutes herself, “she risks dying for the sake of her children.” Sentiments such as this contrast sharply to men’s perceptions of why and how women take up sex work in isolated coastal villages. For example, in an all-male focus group, men reported that “women chase after men” and women “have low moral standards.”

As a result of the gendered power relations in the rural pilot villages, women are more vulnerable to the social and economic impacts of AIDS. Inequalities in access to land, credit, employment, education and information all make women more vulnerable to negative outcomes. Furthermore, women carry the main burden for caring for the sick reducing their ability to engage in productive labor. This includes young girls who drop out of school to help their mothers cope with their increasing workload at home. Apart from the time lost to care giving, household resources are often redirected toward increased healthcare expenditures. Women are often the ones who must make up for these losses.

Due to this context of poverty and structural gender inequality that exists in the study site, women are uniquely vulnerable to HIV/AIDS. But men are also affected by the gender relations and prevailing power structures within their communities. Working environments in this coastal area, such as that of the mineworkers, construction workers, fishermen, and traders, may contribute to male notions of masculinity and sexuality. Next to boredom and loneliness of these jobs, the men endure dangerous and unpleasant working conditions, poor accommodation and isolating environments, to which they may respond with exaggerated “masculinity” and sexual bravado. Increased poverty may further intensify such behavior, leading men to compensate for loss of social value by showing off sexually [41].

3.2. Population mobility

Seasonal migration dominates population dynamics in the eight coastal villages. Throughout the year, men—mostly between the ages of 15 and 39—move between villages
according to fishing and farming seasons. While most migrants come from neighboring villages, large numbers of “outsiders” migrate to both Saadani and Ushongo, where the lucrative shrimp and tuna trades attract businessmen from Zanzibar, Dar es Salaam, and other large towns and cities. During the high fishing season from March to June, migrant fishermen and businessmen pour into Saadani village, swelling the population of the village from 1900 to 3000. The coastal villages, especially Saadani and Sange have a substantially higher annual population growth rate than the national average (6.1% and 4.2% vs. Tanga regional average of 1.8%, the Pwani regional average of 2.4% and the national average of 2.9%).

Overall, the major influence on population dynamics is likely to continue to be seasonal migration, as fishermen and traders move from one village to another according to season, economic environment, and opportunities for employment. However, significant changes in the population composition and size may occur if HIV/AIDS incidence and prevalence rates continue to increase. An increase in tourism activities around the Saadani National Park may also affect population size, composition, economic diversification, and possibly HIV/AIDS prevalence in this coastal area [18]. In recent years, the coastal villages have experienced an influx of so-called “investors” who buy land along the coast and put up hotels. This new development has also acted as an important pull factor for migrants.

Research in Africa has long demonstrated that the prevalence and patterns of the spread of infectious diseases are closely associated with patterns of human mobility [3,6,9]. People become more vulnerable to HIV/AIDS when their work takes them away regularly from home and family. With fewer social ties and lack of social cohesion in settings away from home they are more likely to do things that they would not if they were at home, including taking new sex partners. The optimal context for HIV transmission is one where men have money, have few recreational options, are away from families, and are amid low-income communities where women’s limited access to education, employment, credit or income can force women to resort to sex work to earn a living [42]. This is the reality in the rural fishing communities strung along the coast of Pangani and Bagamoyo.

Studies in Africa have also found that fishers are particularly susceptible to infection of HIV/AIDS and are more vulnerable to the impacts [15,30]. Mobility is thought to be a major factor, together with the availability of cash and sex at landing sites—fueled by a masculine subculture and social marginalization of women [11]. One study of the Kagera region in Tanzania found that fishermen were five times more likely to die from HIV/AIDS than farmers are [12]. Fishing communities in the study site include young men who make up boat crews, fish traders who buy and sell fish (either as agents for a fish company or operating as a small business transporting the fish by bicycle to a market town), and fish processors (women who buy and process fish by frying, salting and sun-drying within the community). People flow into and out of landing sites daily to trade in fresh fish and there is seasonal migration into fishing communities for approximately 4 months of the year. Migrant fishers may spend 3 or 4 months away from their home village to follow the seasonal movement of the fish. Other migrants, mostly from inland areas, are attracted to the prospects of earning a daily wage in the fishing, salt making, or trading businesses. This hub of activity attracts various elements from the service sector, and new bars, eating places, and lodges catering to migrant workers have become intersections for alcohol, drugs, and sex. The recent gazettement of the Saadani National Park is expected to increase tourism activities in the area and hence, attract more migrants. Contrary to some segments of the tourist population in, for example, Kenya and Thailand, which do seek
sex, most tourists in Tanzania probably do not engage in high-risk activities [43]. However, the arrival of new migrants to the area because of tourism could increase the rate of HIV prevalence.

Although certainly not all migrant fishermen seek out commercial or transactional sex, the majority of those who do often place themselves and their partners in highly risky situations by being inebriated, having multiple sex partners, and using condoms inconsistently or not at all. During the fishing season, fishers earn cash on a daily basis, which is easily spent on alcohol and sex when living away from home. They also have a significant amount of free time, as fishing activities usually take place in a 3–5 hour time span in the early morning or evening. Interviews with members in the eight villages confirmed that alcohol consumption, by both men and women, is high, that bars and restaurants are popular entertainment spots, and that taking multiple sex partners and paying for sex are common.

Residents of the two inland farming villages are also susceptible to HIV infection through contact with outsiders, because these villages are located next to train stations. The Sea Salt Works south of Saadani village stores and transports salt at the railway station in Matipwili, attracting large numbers of migrant workers and traders on a seasonal basis.

The village of Ushongo, where residents’ daily lives are regulated by exceptionally strong religious and social norms, appears to be something of an exception. Unacceptable behavior is not tolerated and offending individuals are asked to leave the community. There are no bars and alcohol is rarely consumed (although it is well known that quite a few Ushongo men regularly visit bars in Mwerera village, which is just a few kilometers away). Although there is no evidence that the prevalence rate is lower in Ushongo, it is possible that tight knit traditional communities, where there is a high degree of social capital, are more resilient to fending off the AIDS epidemic. However, the increasing mobility of migrant fishermen and businessmen is increasing the link between people in areas of high HIV-prevalence and villages like Ushongo. Villagers worry about the impacts that increasing numbers of migrant fishermen and traders will have on their tightly knit community and now consider raising awareness about HIV/AIDS extremely important in order to maintain the health of the Ushongo community.

4. Conclusions

Based on observations and findings from the field study, we conclude that AIDS is contributing to natural resource degradation in the project area and that gender inequity, migration, and lack of livelihood options exacerbates the situation. In the eight villages, men and women lives are challenging even without the additional burdens caused by AIDS. The challenges that these men and women must face everyday include drought, poor soil conditions, lack of agricultural productivity, declining fish catch, a lack of improved fishing boats, gear and marketing channels, crop losses due to marauding wildlife, poor physical infrastructure, and inadequate access to reliable transportation, credit, and communications.

Drawing from the literature and our assessment of the villages, we have found that key factors that shape the impact of AIDS on the natural environment include gender inequities, meager livelihoods, and poverty. Addressing these issues is therefore integral to mitigating the impacts of AIDS on unsustainable resource use. The PRA exercise showed
that it is difficult to obtain direct information on HIV/AIDS and to separate the impacts of AIDS on local resource use and biodiversity conservation from other factors driving livelihood practices. Nevertheless, we draw a number of conclusions:

1. There is a trend towards increased destructive practices—especially woodcutting and charcoal making—among AIDS-affected households. It is possible that if the HIV-infection rate rises significantly, the coastal population could decrease to a level where the pressure on natural resources declines. However, established patterns of population movements in the area, especially significant in-migration to coastal villages, suggest that the pressure on natural resources will actually increase over time. Therefore, it is imperative that these communities quickly and effectively address important resource use issues. Unsustainable practices, such as dynamite fishing, poaching, and charcoal making are particularly detrimental to the long-term health of the coastal environment. Opportunities to improve community tenure over the inshore fishery and strengthen community institutions may help reduce the pressure by outsiders. Because livelihood options are limited in the villages, particularly for AIDS-affected households, there is also a need to find less labor-intensive alternatives. Such alternatives might include improved seaweed farming, converting salt ponds to milkfish farms, bee keeping, horticulture, and community-based tourism. All of these activities merit further study and consideration.

2. AIDS-related illnesses have led to loss of staff within organizations that work for biodiversity conservation organizations (park staff, program managers, scientists, district officers, etc.). This contributes to loss in management capacity and institutional memory. It is essential that conservation groups develop and implement HIV/AIDS workplace policies, such as the recently adopted TANAPA policy. These should include plans for how to deal with loss of staff and institutional knowledge—and promote awareness and prevention, VCT, and treatment for employees including extension workers. At village level, environmental committees should look into mainstreaming HIV/AIDS issues into their planning activities, looking into how to preserve indigenous knowledge in the light of increased deaths as a result of AIDS.

3. Women in five of the eight villages admitted that increasing number of women are being forced to barter sex for money and food, thereby exposing themselves to the risk of HIV infection, as well as to unwanted pregnancy, gender-based violence, and stigmatization. Understanding the tremendous gender inequality that currently exists in this coastal area is necessary to understand the root causes of risky sexual behavior, the HIV/AIDS epidemic and poor health in general, and unsustainable resource use. Therefore, over the long term, redressing gender inequality is central to any mitigation strategy. Actions should aim to give women more control over their livelihoods and increased opportunities to engage in income-generating activities; improved access to health care and educational services regarding nutrition, HIV/AIDS and other STIs, and property and ownership rights; leadership development training and increased opportunities to participate in decision-making processes.

4. Women are the hardest hit in terms of HIV-infection rate. Women are also the ones who are responsible for taking care of those who are sick. Whether sick or having to take care of sick family members, women lose precious time and resources due to AIDS. Hence, women and other vulnerable groups, such as grandparent and orphan-headed households, should be a primary target group for efforts to relieve the burdens that
AIDS precipitate. This could include introducing less-labor-intensive livelihoods and developing labor and resource-saving techniques, such as fuel-efficient stoves—helping vulnerable groups while reducing the pressure on natural resources.

5. Most of the pilot villages border the Saadani National Park and are experiencing food shortages in part due to agricultural destruction by wild animals. The villages are also extremely dependent on natural resources for their quality of life and the park reduces total available area for resource extraction. The land cover data demonstrate that the land inside and outside the park is suffering as it is changing from grassland to bare soil. If the 66 km² of marine zone is implemented and enforced as a no-fishing zone, thereby limiting access to fisheries, more conflict with and among neighboring villages could occur. However, permanent closed areas have demonstrated positive long-term benefits for fisheries. Therefore, it is essential that the local community members—both women and men—be involved in the park management and feel that they have something to gain from complying with park rules and zoning plans. Actions should be designed to maximize the empowerment of women and increase household food security. They should also be less labor intensive for families in which one or more family members are suffering from AIDS-related illnesses. It would also be useful to explore benefit sharing and assistance mechanisms with buffer communities in other parks in Tanzania. Similarly, it is important to increase investments in awareness raising around coastal resources and biodiversity management.

6. Since six of the pilot villages are dominated by artisanal fishing and experience a high degree of mobility among fishers, these communities are particularly vulnerable to HIV infection. Three villages (Sange, Ushongo, and Saadani) experience substantial seasonal migration during the shrimp and tuna seasons. Seasonal migrants are vulnerable groups, and more likely to engage in risky sexual behavior and the spreading of HIV. It is important to target migrant fishermen and salt workers for HIV/AIDS-prevention programs, providing educational materials and improved health services. In addition, community members must understand and carefully consider the links between AIDS and sustainable resource use when developing environmental management plans. The villages will likely need technical assistance in developing such environmental and HIV/AIDS plans, including training and financial assistance. Assistance could come from conservation organizations, which could partner with health organizations to integrate HIV/AIDS into their community programs and advocate for access to VCT and treatment.

This study has attempted to illustrate the linkages between, and challenges associated with, HIV/AIDS, gender, migration, and coastal biodiversity. However, more time in the eight communities and more household surveys and data analysis would be needed to completely disentangle the possible impacts of AIDS on local resource use, gender relations, and the factors driving livelihood practices. Despite these limitations, we gathered important information about gender relations, livelihoods, and biodiversity that can inform the development of action strategies to prevent or mitigate the impacts of AIDS on biodiversity conservation for this area as well as inform those working in other coastal areas where HIV/AIDS is prevalent. Small, targeted actions can be identified that can provide short-term economic benefits to local communities, while also improving the level of care and support to AIDS-affected families and other vulnerable groups. It will be equally important to build upon synergies between HIV/AIDS, rural poverty, and natural
resources management to develop multi-sectoral national policies and programs. This could include mainstreaming HIV/AIDS, gender, and population issues into existing conservation and natural resources management-related policies and plans and developing HIV/AIDS workplace policies and procedures for natural resources management organizations. It will also be important to train natural resources and production-oriented extension personnel to better address the needs of vulnerable groups, especially women and AIDS-affected households.

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